



# *Solar Eclipse Imaging: Tips, Tricks & Tools*

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By: Susan Sawyer-Beaulieu, Ph.D., P. Eng.

For: RASC Windsor Centre

February 20, 2024

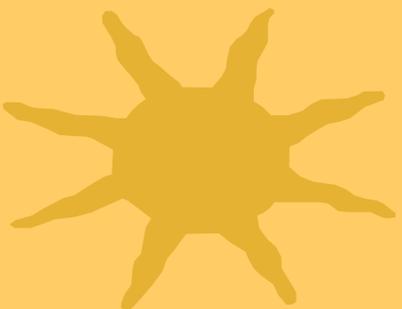


# *Presentation Outline*

## I. DIY Solar Filters

## II. Solar Eclipse Imaging - Considerations when deciding on an imaging plan:

1. Location? Where will you go to see the eclipse?
2. Equipment selection? What will you use?
3. What solar features will you capture with the selected equipment?
4. What settings will you use to capture the different solar features?





## *Not covered in this Presentation*

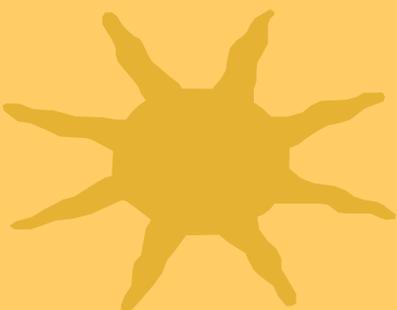
- **Imaging System Basics**, i.e. what is
  - Prime Focus vs Afocal vs Positive/Negative Lens Projection
- **Types of Imaging Equipment:**
  - CCD/CMOS cameras vs DSLR cameras vs Point-and-shoot cameras (including Smartphones)
- **Solar Imaging Work Flow**
- **Software Tools for Image Acquisition & Image Processing**

*... See April 18, 2017 presentation, “Getting Into Digital Solar Imaging” (<https://www.rascwindsor.com/media/pdf/Getting%20Into%20Solar%20Imaging.pdf>)*

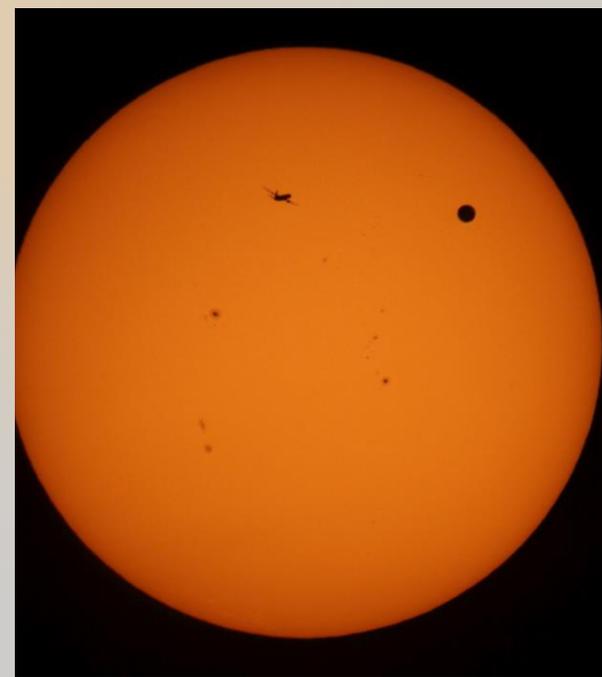


## *DIY Solar Filters – Thin-film Based*

- Availability of thin-film filter materials makes do-it-yourself solar filters easy and affordable
- Appearance of sun through solar filters varies with the material.



Sun  
through  
Baader  
AstroSolar  
Safety  
Film



Typical Sun  
through  
black  
polymer  
thin-film,  
glass solar  
filters, etc.



# *DIY Solar Filters – Styles*

## **Cap-style**

- Slips over end of telescope



## **Plug-style**

- Slips into end of telescope





# *DIY Solar Filters – Construction Techniques*

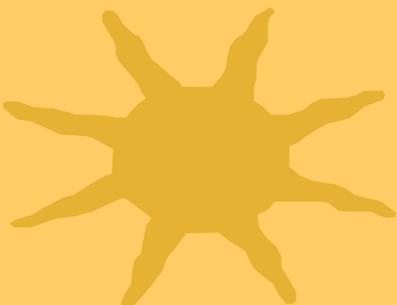
- **Instructions for “do-it-yourself” filters**, for example:
  - Baader Planetarium, “How to make your own Solar Filter for Telescopes, Binoculars and Cameras” (<https://astrosolar.com/en/information/how-to/how-to-make-your-own-objective-solar-filter-for-your-camera-or-telescope/>)
  - Baader Planetarium, “How to make an inexpensive filter cell” (<https://astrosolar.com/en/information/how-to/how-to-make-an-inexpensive-filter-cell/>)
  - Baader Planetarium, “Constructing a Solar Filter for Binoculars” (<https://astrosolar.com/en/information/how-to/how-to-make-an-inexpensive-filter-cell/>)
  - Joe Cali’s “Mounting A Thin Film Solar Filter” (<http://joe-cali.com/eclipses/EQUIPMENT/solarfilters.html>)





# DIY Solar Filters – Construction Techniques

- Instructions for “do-it-yourself” filters, example:
  - “How to make an inexpensive filter cell”



BAADER PLANETARIUM - making of an inexpensive filter cell

**BAADER PLANETARIUM GmbH**

order form | Filter Cell Mount | Interferometric Protocol | tech. Info

Here You are invited to download a pdf-file (140 Kby) with the description of “Constructing a Solar Filter for Binoculars with Baader Astro Solar Film™”

▶ Making an inexpensive filter cell for BAADER AstroSolar™ Safety Film

The film must be mounted flat and free of any tension - Only this will provide first class Solar images. The quality of this patent pending material is so high that any wrinkles or strain on the film will lead to a very noticeable deterioration of optical quality.

When mounted carefully, AstroSolar™ Film can reach the quality levels of truly precision polished glass plates (not to compare with several glass filters made of ordinary window glass who ever having seen a polishing machine).

**The “Cylinder”**

At first you have to produce a cylinder of cardboard, to exactly match the outer circumference of your Telescope tube or dew cap. In order to achieve this, cut a whole number of cardboard layers, approx. 5 -6cm (2 inches) wide. Wrap one piece of cardboard around your dew cap or lens cell and glue one end onto the other.

Fasten a second and third a.s.f. layer of cardboard in the same manner, until you have manufactured a stiff roll of cardboard, approx. 4 - 5mm thick. Watch out that the finished “cylinder” will slide snugly over the tube and that it will be easy to slide it on and off the telescope.

**Hint:** For telescopes with smaller aperture one could try to find an appropriate “poster tube” and cut off a piece of approx. 5 - 6cm length. Variations in diameter could be equalized by using adhesive felt liner or by gluing Kork pads into the paper tube.

**The “Filter Cell”**

Cut out two rings of cardboard (each having 1 - 2mm thickness). The outer diameter of the ring - shaped cardboard should match the outer diameter of your fabricated “cylinder”. The inner diameter should correspond to the actual aperture of the instrument (some mm less may improve on image quality, due to hiding sunken edges on imported objective lenses).

After having prepared two such rings, both should be equipped on adjacent sides with a large number of small cutouts of double tape along the outer circumference of both rings. Now comes the tricky part - how to get the Solar film onto the taped ring who wrinkles or ripples. The film must not be scratched -

[http://www.baader-planetarium.com/softfile/busanleitang\\_c.htm](http://www.baader-planetarium.com/softfile/busanleitang_c.htm)[2012-02-24 9:42:18 AM]

her soft tissue) onto a flat table. Tape the film is stretched out evenly and cannot move if film - (precut to the size of the tissue. Do not tape the film and do not on the Kleenex.

Now take the first cardboard ring and lower it straight down onto the film until every double tape clipping made contact with the film. Turn this package around, tape the other ring onto the opposite side and cut away the overleaf. Now your AstroSolar™ film should be mounted free from strain and wrinkles between the two cardboard rings. Finally glue this “filter holder” onto the prefabricated “cylinder”. Now your “Do it Yourself” filter is ready. Enjoy it - you just saved about US\$ 100 - for the filter cell alone.

Schmidt-Cassegrain Telescope for Solar I Do not try to make a filter as large as bigger aperture will greatly be secondary mirror obstruction. Rather view the sun with a smaller (but much try reflecting telescope may be raised in a good refractor.

**safety precautions with EVERY solar observation**

ation session, check the filters fit and - if necessary - tape it to prevent slipping. ly attach it onto the front of the objective, in front of the Schmidt-plate (SC-owners) or scope. Otherwise it can become dangerously hot inside your instrument and inside

bjectives with a filter. Also make sure, that the viewfinder of your telescope is t the original dust cover. Unprotected views through your finderscope would have the our eyes as a look through the main telescope itself!

stant to breakage in comparison to a glass filter. However, care should be taken with

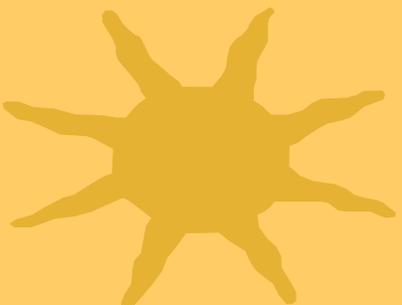
on to those observing with you, especially children. Intentionally removing or damaging This is no place for jokes. Never leave the telescope outside unattended during the

[http://www.baader-planetarium.com/softfile/busanleitang\\_c.htm](http://www.baader-planetarium.com/softfile/busanleitang_c.htm)[2012-02-24 9:42:18 AM]



# DIY Solar Filters – Construction Techniques

- Instructions for “do-it-yourself” filters, example:
  - “How to make your own Solar Filter for Telescopes, Binoculars and Cameras”



**AstroSolar.com** © Baader Planetarium GmbH, 2017. All rights reserved.

### HOW TO build your own SOLAR FILTER for Telescopes, Binoculars and Cameras

planeoptically correct mounting of BAAADER AstroSolar® Safety Film 5.0 in DIY filter cell

**What you need:**

- Baader AstroSolar® Safety Film 5.0
- two sheets of white stiff cardboard
- pair of scissors
- compass to draw circles
- Some pieces of “Kleenex”- tissue
- double-faced adhesive tape
- Paper glue

**RESULT:** Self-made Solar Filter attached onto Celestron AstroMaster 70mm refractor

- Using the compass, draw two circles on pieces of stiff cardboard. The inner diameter should match the full aperture of the objective lens, the outer diameter should be 10cm (~4”) larger. Cut the two disks from the cardboard.
- In order to minimize the volume of air between the filter and objective lens, it is advisable to mount the ready made filter directly onto the tube of the telescope / binocular, rather than onto an additional dew cap. If the dew cap cannot be removed from your telescope, its outer diameter will provide the minimum size of the outer ring of your cardboard disk.
- Cover one full face of each cardboard-ring with sticky tape. Cleanly cut away any inner and outer excess tape, so that only the two cardboard faces of both rings are covered with the sticky tape.
- Stretch out a square piece of “Kleenex” or similar facial tissue flat on a hard, plane surface (a table) and secure the four corners of the tissue with clear adhesive tape. The tissue must be free of any wrinkles.
- Cut a square piece of AstroSolar® Safety Film 5.0 a little larger than the outer diameter of the stiff cardboard rings. The film must be mounted into the filter cell without any of the protective layers of plastic or paper. However, for cutting AstroSolar® Safety Film 5.0, always keep it protected between the included two sheets of protective layers (white silk paper and/or transparent or white plastic). This “sandwich” is easily cut without creasing the film or getting fingerprints on it. The latest version of AstroSolar® Safety Film 5.0 comes with protective layers already on both sides.
- Gently place the cutout of AstroSolar® Safety Film 5.0 onto the flat tissue and secure the four corners with tape – but do not stretch it! At this time carefully remove the protective layer facing upwards. AstroSolar® Safety Film 5.0 must not be put under tension in order to retain its precision optical property.

[www.baader-planetarium.com](http://www.baader-planetarium.com) | [www.celestron.de](http://www.celestron.de) | [www.astrosolar.com](http://www.astrosolar.com)

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with the sticky side facing downwards, the film and let it fall down onto the AstroSolar® ring touches the film all around at the

ring with the film-covered side facing upward onto the Kleenex. **Now remove the second** and stick the second cardboard ring against the tissue with the other ring already attached to the telescope. The film is now secured and sealed securely fastened, without creases and wrinkles. The filter is now ready for use!

Apply strips of strong cardboard around the objective cap and tape the ends with double-faced adhesive tape. Repeat this procedure 3 times between each layer to form a sturdy cardboard cylinder that precisely fits onto

holder containing the AstroSolar® Safety Film 5.0 onto the 50mm cylinder mounted at the front end of your telescope.

**Filter for visual and photographic use is now ready! Store it properly!**

EN ISO 12312-2:2015-11 for naked eye solar viewers does not apply to front aperture filters, covering only Safety Film 5.0 is not authorized to be used for naked eye solar observation or production of solar viewers, telescope, binocular or camera optics, inquire for our EN ISO 12312-2:2015-11 certified eclipse shades and film.

**Use AstroSolar® Safety Film 5.0 for...**

... Teleskops ... Binokulars

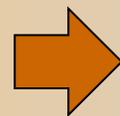
[www.baader-planetarium.com](http://www.baader-planetarium.com) | [www.celestron.de](http://www.celestron.de) | [www.astrosolar.com](http://www.astrosolar.com)



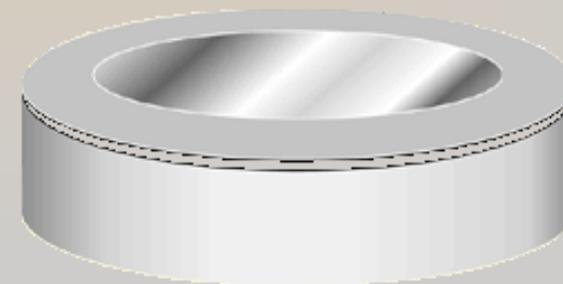
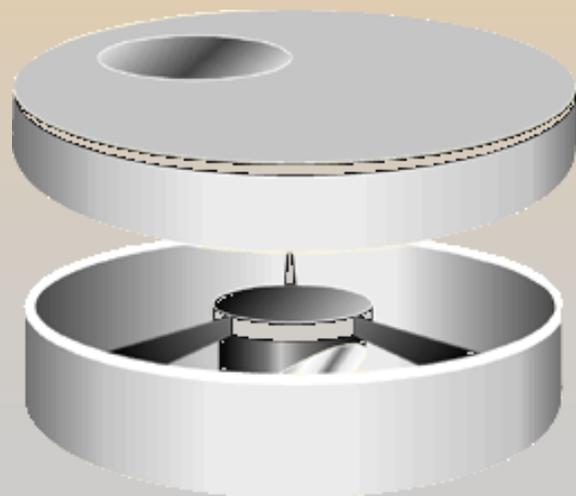
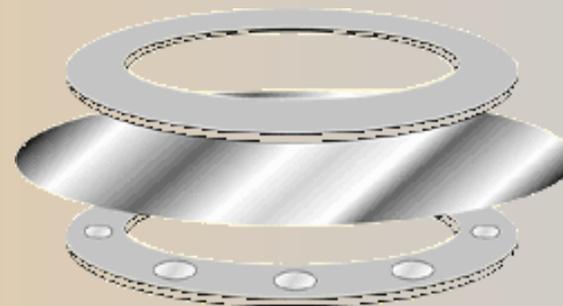
# *DIY Solar Filters – Construction Techniques*

- Making an inexpensive filter cell:

The “Cylinder”



The “Filter Cell”





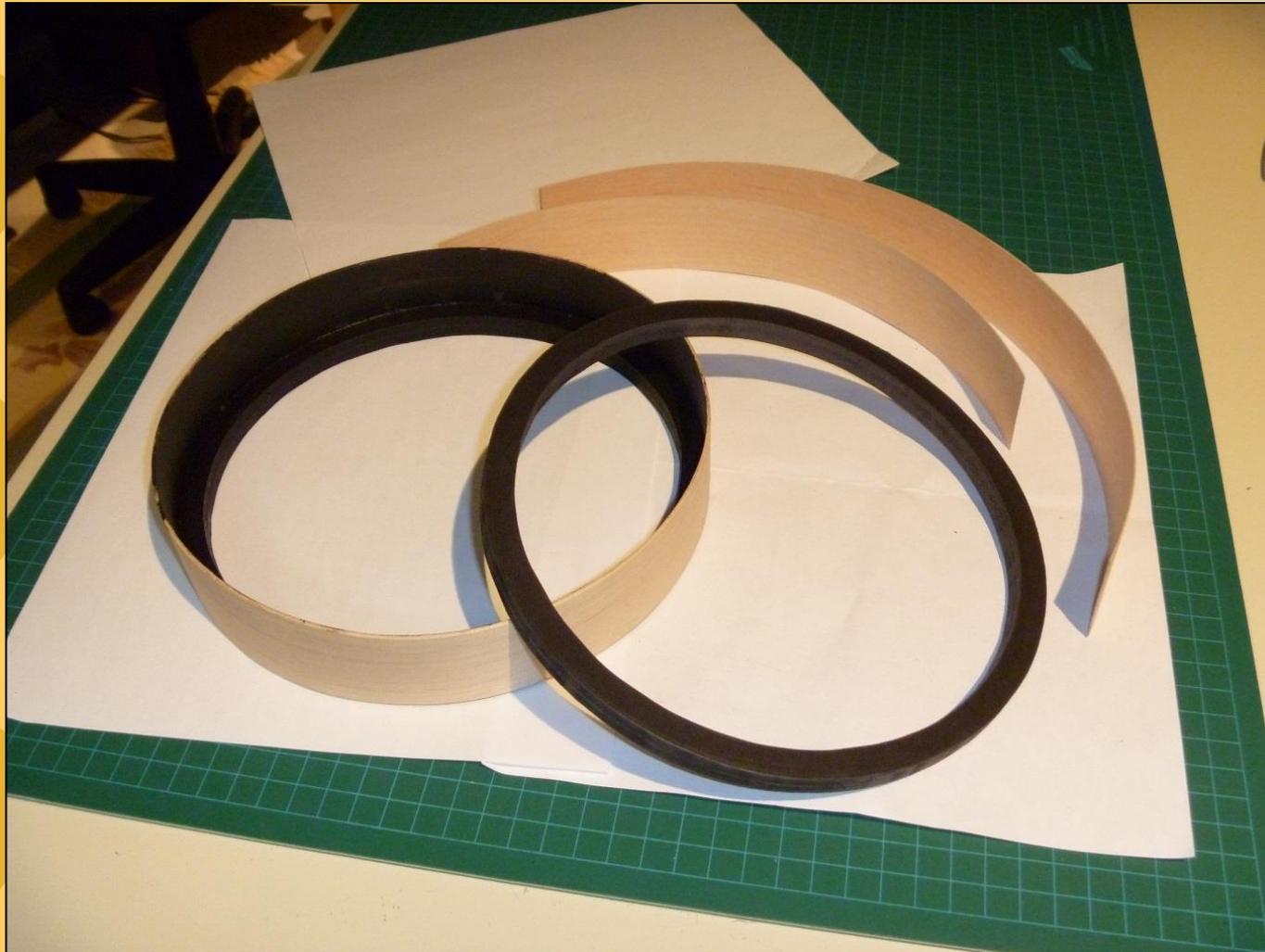
## *DIY Solar Filters – Materials*



- Foam core (black; white)
- Matte board
- Bristol board
- Corrugated cardboard
- Craft foam
- Empty cardboard “cans”
- Wood veneering



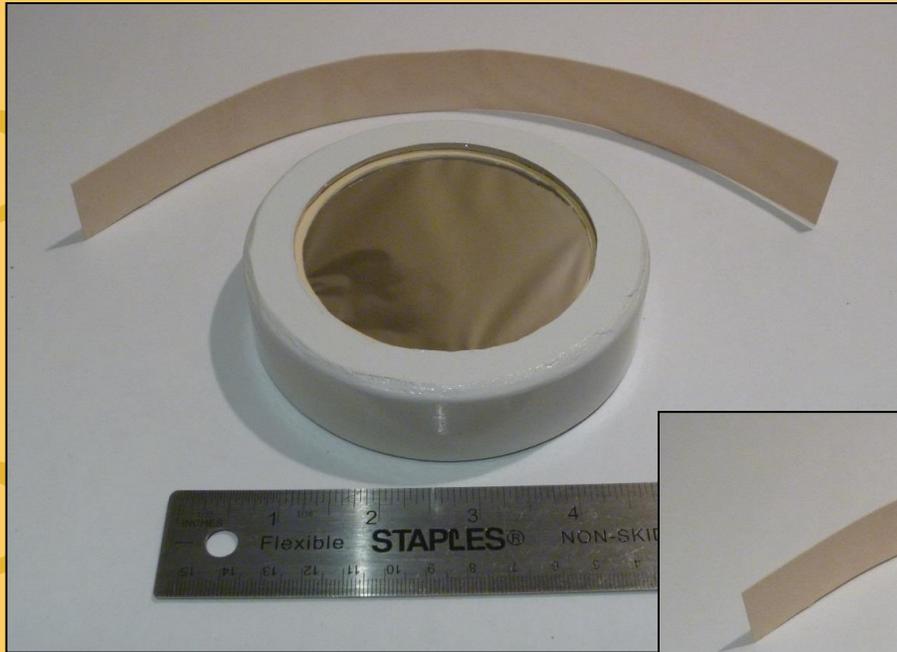
## *DIY Solar Filters – Materials*



- 6-inch “cell” in progress
- Cap-style cell made with a foam core ring and laminated wood veneer outer “cylinder” (wood veneer layers glued to foam core)



# DIY Solar Filters – Materials



**80mm solar filter  
with Baader  
AstroSolar Safety  
film**



- Cap-style filter made with matte board front face ring mounted on a laminated wood veneer “cylinder”
- Filter “cell” consists of Baader thin-film sandwiched between two Bristol board rings (black ring inside; white ring outside); secured in place using double-sided sticky tape
- Filter “cell” can be easily removed from “cylinder” and thin-film replaced if damaged.





# DIY Solar Filters – Materials



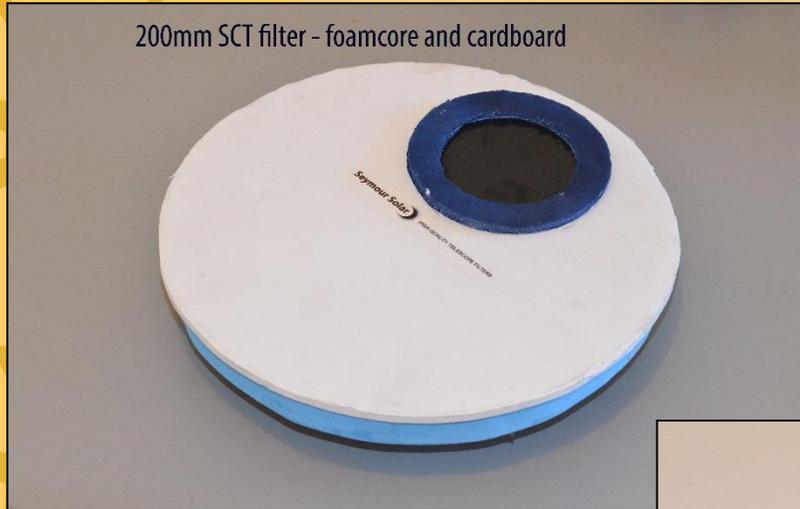
**4in (100mm) Solar Filter with Baader AstroSolar Safety film**



- Plug-style filter made out of end of empty cardboard can
- Filter “cell” Baader thin-film sandwiched between two Bristol board rings (black ring inside; white ring outside); secured in place using double-sided sticky tape
- Filter “cell” can be easily removed from “cylinder” and thin-film replaced if damaged.



## *DIY Solar Filters – Materials*



- Off-axis black polymer thin-film solar filter, for 80mm SCT, with foam core board front face mounted on laminated cardboard “cylinder”

*Filter pictures courtesy of Mahayarrahh-Starr Livingstone*



# DIY Solar Filters – Materials



- 80mm refractor filter made from a PVC pipe cap
- 50mm finder scope filter made using a plastic cap from a spray can

*Filter pictures courtesy of Mahayarrahh-Starr Livingstone*



## *DIY Solar Filters – Materials*



- Baader AstroSolar Safety film mounted in an embroidery hoop

*Picture source:  
<http://www.cloudynights.com/topic/423396-solar-film-options/>*



# *Solar Eclipse Imaging*

- Solar eclipse imaging with a telescope or lens equipped with a white light filter
- Images captured with a digital camera, focusing on DSLRs / Mirrorless

May 10th, 1994 Annular Solar Eclipse





## *What Is Your Imaging Game Plan?*

1. Where will you set-up?
2. What equipment will you use?
3. What features do you want to capture and/or what are your imaging goals?
4. What settings will you use?

Note: These decisions are not mutually exclusive; they are likely to be interdependent





# *What Is Your Imaging Game Plan?*

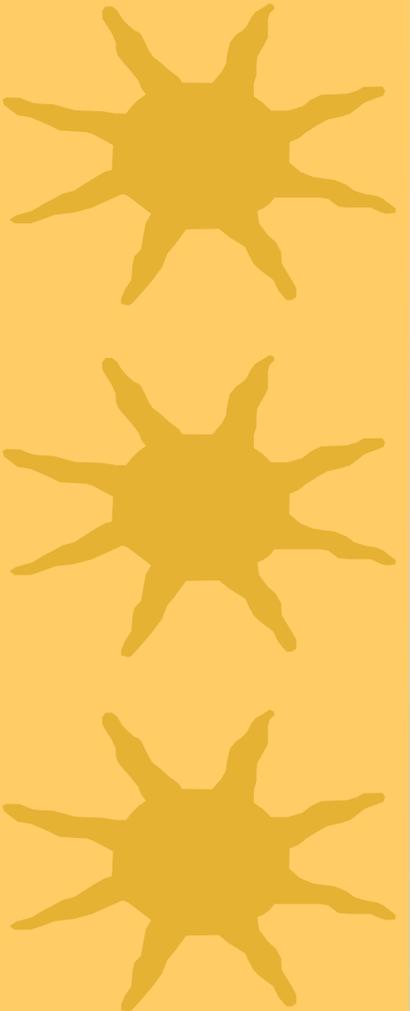
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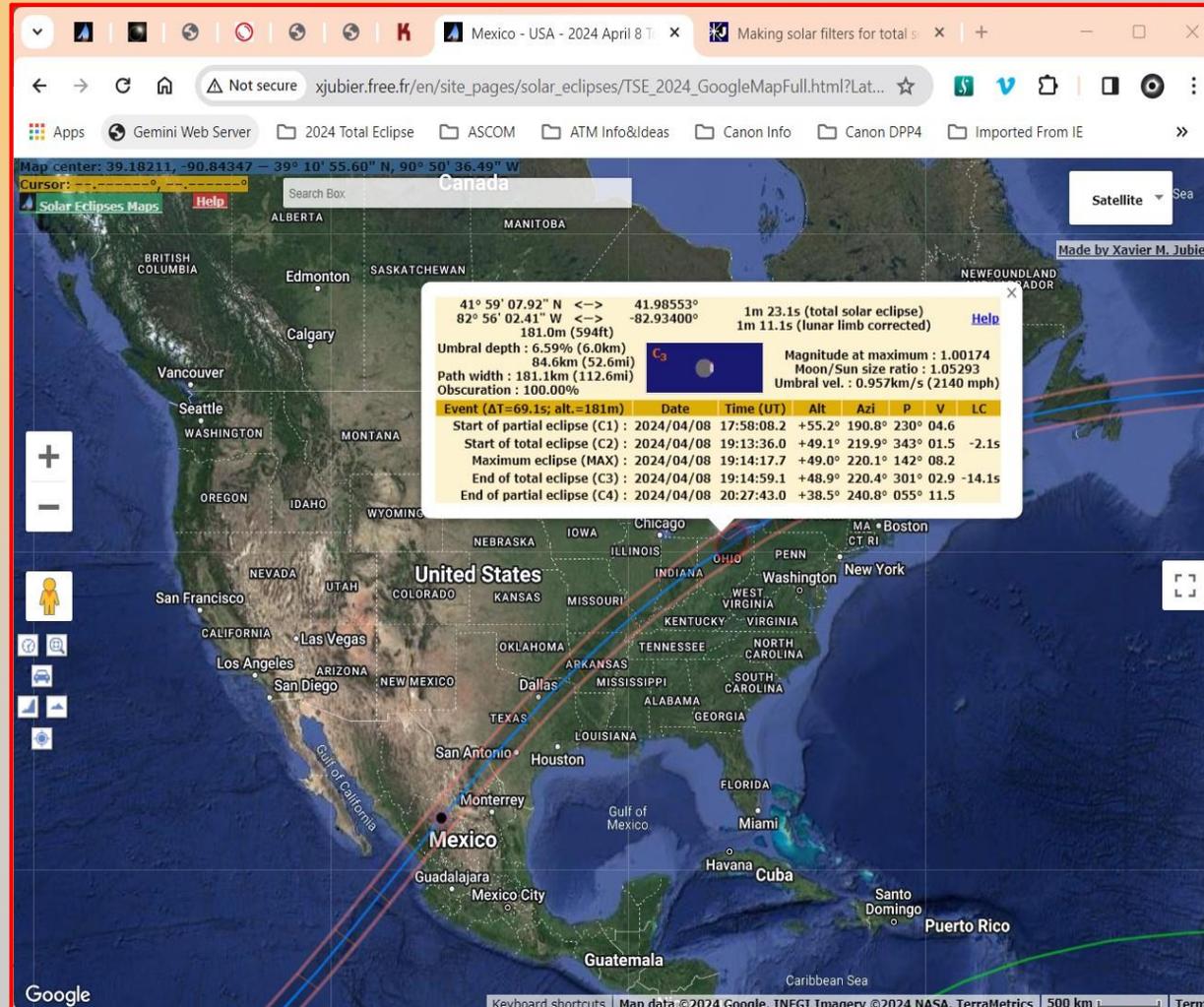


# Interactive Google Map, by Xavier Jubier

[http://xjubier.free.fr/en/site\\_pages/solar\\_eclipses/TSE\\_2024\\_GoogleMapFull.html](http://xjubier.free.fr/en/site_pages/solar_eclipses/TSE_2024_GoogleMapFull.html)



Best way  
to select a  
location?  
Use a  
map...





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[http://xjubier.free.fr/en/site\\_pages/solar\\_eclipses/TSE\\_2024\\_GoogleMapFull.html](http://xjubier.free.fr/en/site_pages/solar_eclipses/TSE_2024_GoogleMapFull.html)

**Map center latitude/longitude**

**Cursor latitude/longitude position on map**

**Change map style**

**Drag Pegman onto map to open Street View**

**Turn on/off time zone display**

**Display/hide road traffic on map**

**Turn on/off day/night display**

**Turn on/off geolocation tracking**

**Zoom on/off**

**Turn on/off elevation & terrain profile computations**

**Toggle on/off fullscreen view**

**Information Popup:**

41° 59' 07.92" N <-> 41.98553°  
 82° 56' 02.41" W <-> -82.93400°  
 181.0m (594ft)  
 1m 23.1s (total solar eclipse)  
 1m 11.1s (lunar limb corrected)

Umbral depth : 6.59% (6.0km)  
 84.6km (52.6mi)  
 Path width : 181.1km (112.6mi)  
 Obscuration : 100.00%

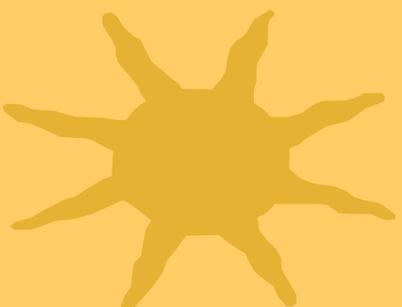
Magnitude at maximum : 1.00174  
 Moon/Sun size ratio : 1.05293  
 Umbral vel. : 0.957km/s (2140 mph)

Event (Δt = 69.1s; alt. = 181m)	Date	Time (UT)	Alt	Azi	P	V	LC
Start of partial eclipse (C1)	2024/04/08	17:58:08.2	+55.2°	190.8°	230°	04.6	
Start of total eclipse (C2)	2024/04/08	19:13:36.0	+49.1°	219.9°	343°	01.5	-2.1s
Maximum eclipse (MAX)	2024/04/08	19:14:17.7	+49.0°	220.1°	142°	08.2	
End of total eclipse (C3)	2024/04/08	19:14:59.1	+48.9°	220.4°	301°	02.9	-14.1s
End of partial eclipse (C4)	2024/04/08	20:27:43.0	+38.5°	240.8°	055°	11.5	



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[http://xjubier.free.fr/en/site\\_pages/solar\\_eclipses/TSE\\_2024\\_GoogleMapFull.html](http://xjubier.free.fr/en/site_pages/solar_eclipses/TSE_2024_GoogleMapFull.html)



Take a closer  
look at  
geolocation  
tracking  
data

Map center: 41.98383, -82.93395 — 41° 59' 01.79" N, 82° 56' 02.22" W

Cursor: 41.98383, -82.93395

Time Zone: UTC-05:00 (America/Toronto)  
DST: Yes  
Local Time: UTC-04:00

41° 59' 01.79" N <-> 41.98383°  
82° 56' 02.22" W <-> -82.93395°  
181.0m (594ft)

1m 24.2s (total solar eclipse)  
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Umbral depth : 6.77% (6.1km)  
84.4km (52.5mi)  
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Event (AT=69.1s; alt.=181m)	Date	Time (-4.0)	Alt	Azi	P	V	LC
Start of partial eclipse (C1)	2024/04/08	13:58:08.0	+55.2°	190.8°	230°	04.6	
Start of total eclipse (C2)	2024/04/08	15:13:35.4	+49.1°	219.9°	343°	01.5	-2.3s
Maximum eclipse (MAX)	2024/04/08	15:14:17.6	+49.0°	220.1°	142°	08.2	
End of total eclipse (C3)	2024/04/08	15:14:59.6	+48.9°	220.4°	301°	02.9	-13.7s
End of partial eclipse (C4)	2024/04/08	16:27:43.0	+38.5°	240.8°	055°	11.5	

Google Keyboard shortcuts Map data ©2024 Imagery ©2024 Airbus, CNES / Airbus, Maxar Technologies, U.S. Geological Survey, USDA/FPAC/GEO 50 m Terms



# Interactive Google Map, by Xavier Jubier

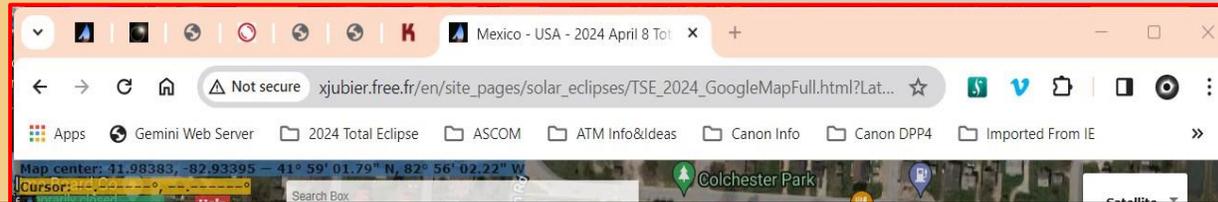
[http://xjubier.free.fr/en/site\\_pages/solar\\_eclipses/TSE\\_2024\\_GoogleMapFull.html](http://xjubier.free.fr/en/site_pages/solar_eclipses/TSE_2024_GoogleMapFull.html)



Site Latitude,  
Longitude and  
Elevation

Solar Eclipse Contact  
(C1,C2,C3,C4) & Max  
Eclipse Date and Times  
(UT or Local; when time  
zone display is turned on  
and off, eclipse times  
change from Local time to  
Universal time,  
respectively);  
Sun's Altitude (Alt) and  
Azimuth (Azi)

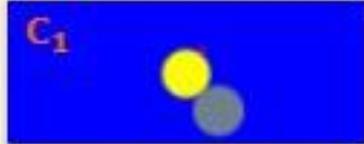
Duration of  
Totality at  
Selected  
Location



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End of partial eclipse (C4)	2024/04/08	20:27:43.0	+38.5°	240.8°	055°	11.5	

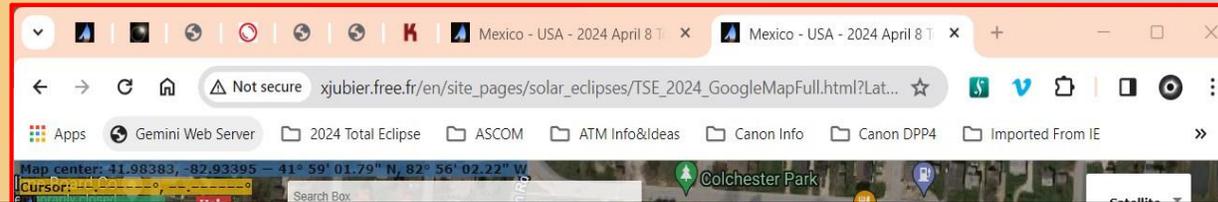




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**Make note of the Site elevation data and Sun altitude data**



41° 59' 01.79" N <--> 41.98383°  
 82° 56' 02.22" W <--> -82.93395°

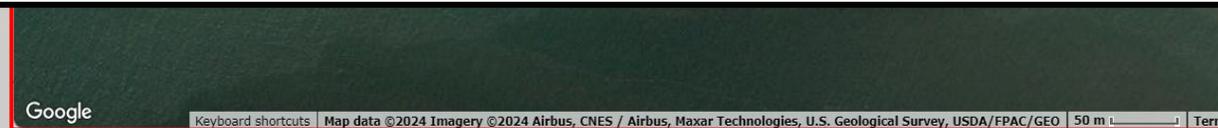
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- 2. What equipment will you use?**
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Note: These decisions are not mutually exclusive; they are likely to be interdependent





## *What Is Your Imaging Game Plan?*

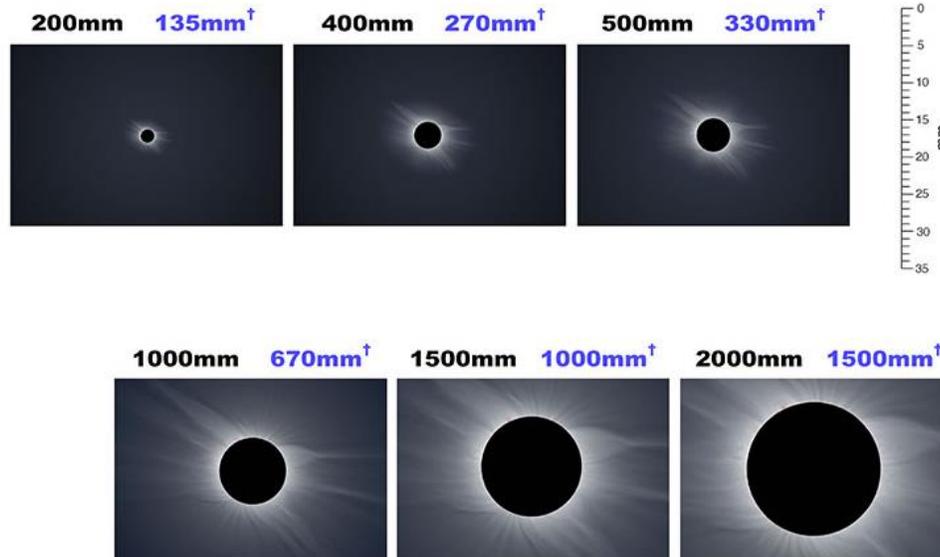
- What equipment will you use?
  - Camera and telescope?
  - Camera and telephoto lens?
  - Camera and wide angle lens?
  - Tracking or non-tracking mount?
- This is very much a personal choice, a choice that will influence the size of the sun's image that's captured on the camera sensor.





# What Equipment To Use?

## Lens Focal Length vs. Image Size – Total Solar Eclipses



Focal lengths in **BLACK** are for Full Frame DSLRs.

<sup>†</sup>Focal lengths in **BLUE** are for Crop Sensor DSLRs.

[www.MrEclipse.com/SEphoto/SEphoto.html](http://www.MrEclipse.com/SEphoto/SEphoto.html)

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- Use planetarium software to estimate size of Sun's image on camera sensor, e.g.,
  - Sky Safari Plus/Pro
  - Stellarium
  - Earth Centred Universe
  - Starry Night, etc.

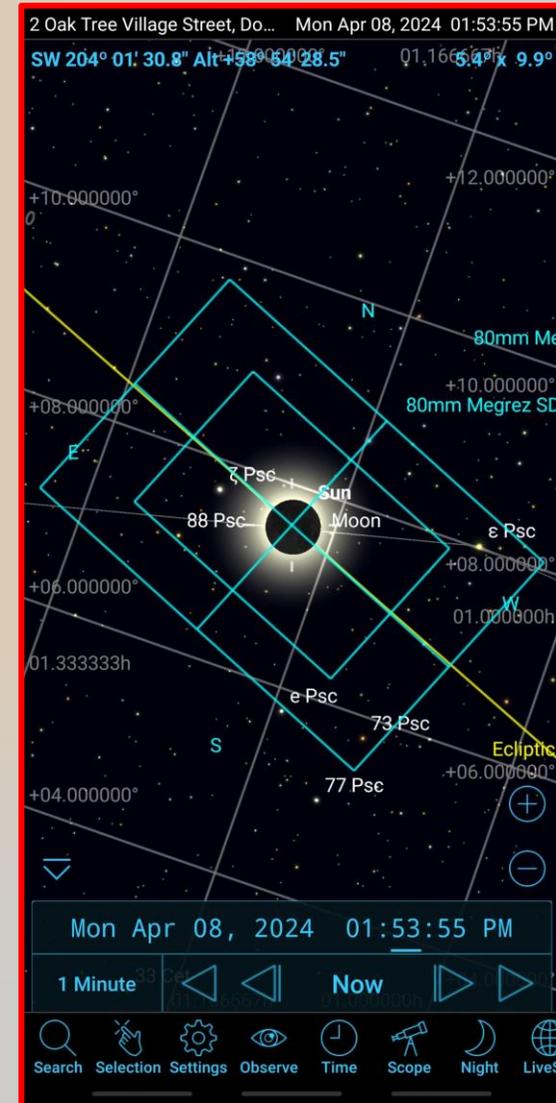
Source: How to Photograph a Total Solar Eclipse, by Fred Espenak,  
<https://www.mreclipse.com/SEphoto/SEphoto.html>



# Example of Image Size on Camera Sensor



- Screenshot of SkySafari Pro showing fields of view for Canon 5D Mark IV full frame DSLR through a William Optics Megrez 80mm, 480mm f.l. refractor telescope at:
  - 1) f/6 (prime focus), represented by larger rectangular field-of-view of  $4.3^\circ \times 2.9^\circ$  and,
  - 2) f/9.6 using 1.6x Barlow lens (i.e., negative eyepiece projection), represented by smaller rectangular field-of-view of  $2.7^\circ \times 1.8^\circ$
- Note: Sun is  $\frac{1}{2}^\circ$  (30 arc min) in size





## *What Is Your Imaging Game Plan?*

1. Where will you set-up?
2. What equipment will you use?
- 3. What features do you want to capture and/or what are your imaging goals?**
4. What settings will you use?

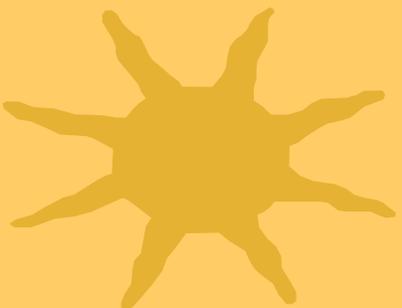
Note: These decisions are not mutually exclusive; they are likely to be interdependent





# *What To Image?*

- What features do you want to capture and/or what are your imaging goals?
  - *Partial phase animation?*
  - *Corona composite?*
  - *Diamond ring?*
  - *Baily's Beads?*
  - *Chromosphere and prominences?*
  - *Earthshine and stars?*
  - *Wide-angle "montage" of inbound partial phases, totality and outbound partial phases*



**Diamond  
Ring ?**

# *What To Image?*



**Chromosphere  
and  
prominences?**



© 2017 Susan Sawyer-Beaulieu

**Corona?**

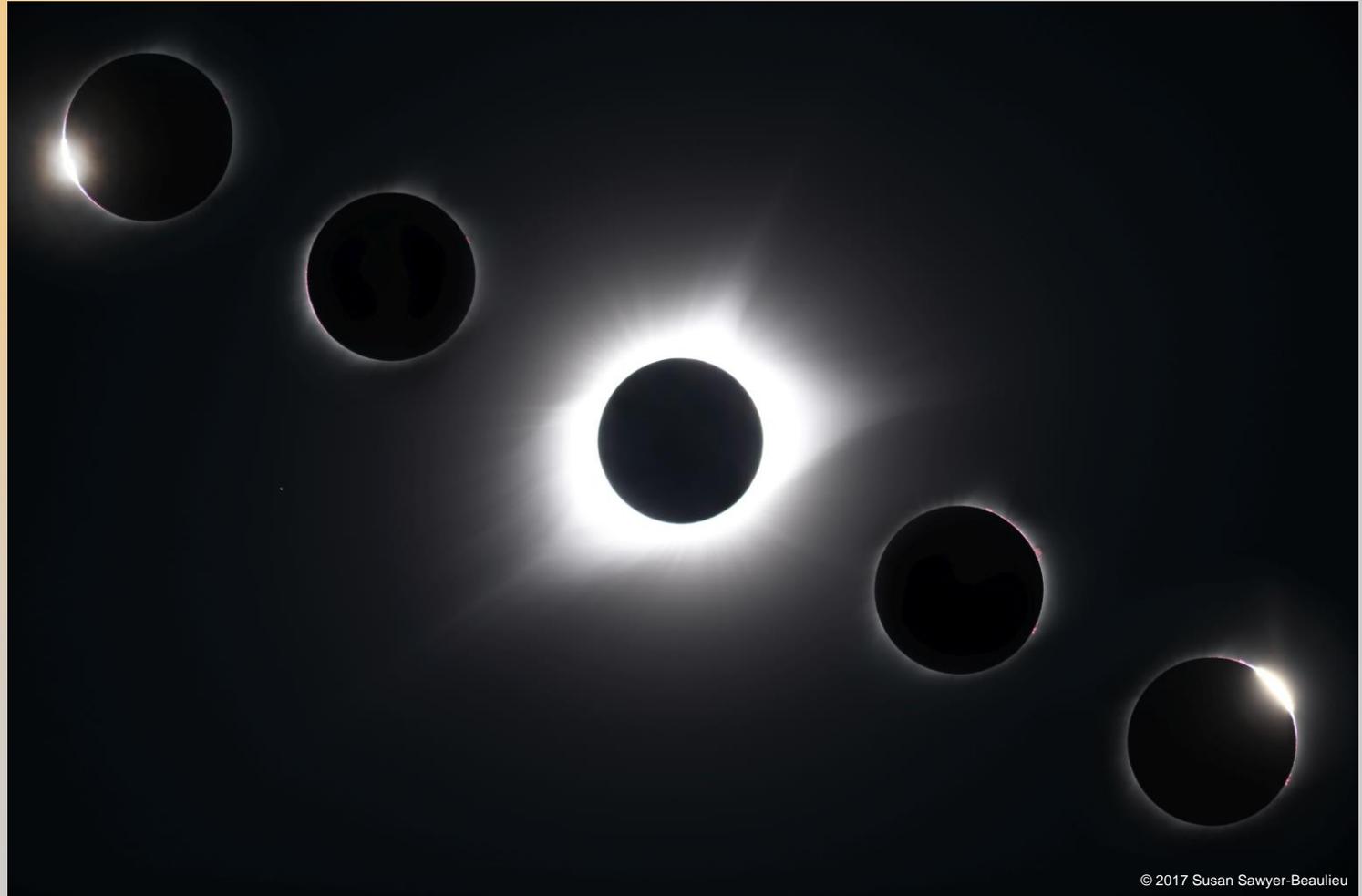


© 2017 Susan Sawyer-Beaulieu



## *What To Image?*

- Montage of 2017 Total Solar Eclipse inbound and outbound diamond rings, prominences, corona and Regulus





## *Wide Angle Solar Eclipse Imaging?*

- With a nice foreground scene, a wide field view of a solar eclipse can be captivating.
- For a good example, see Fred Espenak's 2017 Total Solar Eclipse wide-field montage, <https://www.mreclipse.com/SEphoto/TSE2017/TSE2017-W1037seq2.html>
- The World Wide Web is a good source of examples of solar eclipse images, often including descriptions of the conditions, equipment and camera settings used.





## *What Is Your Imaging Game Plan?*

1. Where will you set-up?
2. What equipment will you use?
3. What features do you want to capture and/or what are your imaging goals?

### **4. What settings will you use?**

Note: These decisions are not mutually exclusive; they are likely to be interdependent





# Shutter Speed Calculator for Solar Eclipses by Xavier Jubier,

[http://xjubier.free.fr/en/site\\_pages/SolarEclipseExposure.html](http://xjubier.free.fr/en/site_pages/SolarEclipseExposure.html)

The screenshot shows the 'Shutter Speed Calculator for Solar Eclipses (v1.0.2)' website. The interface is in French. It features several input fields and calculated results:

- Altitude of the Sun:** 90.0°
- Elevation of the Observer:** 0 m
- Eclipse Event:** Partial phase — 1/10000<sup>th</sup> filter (ND 4.0) is selected.
- Camera Settings:** Sensitivity (ISO): 100, Lens aperture (f/Number): 8.
- Miscellaneous Camera Information:** Sensor Type: Full-Frame, Effective MPix: 12, Lens Focal Length: 18mm, Effective Focal Length: 18mm.
- Field of View:** 90.0°x67.4° (100.5°)
- Exposure Limit (without tracking):** 11 s
- Sampling:** Body: Nikon D850, Effective MPix: 45, Pixel Size: 4.3µm x 4.4µm, Sampling: 4.43"/pixel.
- Instructions:** To display the suggested time exposure for one of the solar eclipse events, select the event, the sensitivity (ISO) and the lens aperture (f/number). The altitude of the Sun and elevation of the observer do have a measurable influence on the exposure time, just as the sky conditions. The time exposure will then be displayed and computed every time you modify one of those parameters.

Calculated results:

- Suggested shutter speed:** 1/6400 s
- With atmospheric extinction:** 1/5000 s
- Brightness (Q):** 11.6
- Exposure Value (EV):** 18.3

At the bottom left, there is a weather widget showing 12°C, Humidité: 73%, and Vent: 22 km/h. At the bottom right, there is a copyright notice: © Xavier M. Jubier, 1991-2024. Last page update on July 3, 2017.

- Nifty tool for **estimating** shutter speeds to use for solar eclipses.
- Need to know:
  - Site elevation (m) and sun's altitude (°); e.g. 181m and 55°
  - ISO and aperture to be used, i.e., aperture of lens/telescope



# Shutter Speed Calculator for Solar Eclipses by Xavier Jubier, [http://xjubier.free.fr/en/site\\_pages/SolarEclipseExposure.html](http://xjubier.free.fr/en/site_pages/SolarEclipseExposure.html)



## Calculator to Estimate Shutter Speed, data to enter:

- Sun's Altitude
- Elevation of Observer
- ISO to be used
- Aperture of lens/telescope

## Calculator to Estimate Size of Field of View, data to enter:

- Camera sensor type
- Lens/telescope focal length
- Effective Megapixels of sensor

## Calculator to Estimate Sampling Rate, data to enter:

- Camera body (i.e., make & model)
- Lens/telescope focal length





# Shutter Speed Calculator for Solar Eclipses by Xavier Jubier, [http://xjubier.free.fr/en/site\\_pages/SolarEclipseExposure.html](http://xjubier.free.fr/en/site_pages/SolarEclipseExposure.html)

**Shutter Speed Calculator for Solar Eclipses (v1.0.2)**

Altitude of the Sun	Elevation of the Observer	Miscellaneous Camera Information		
90.0°	0 m	Sensor Type: Full-Frame	Effective MPix: 12	
<b>Eclipse Event</b>		Lens Focal Length: 18mm	Effective Focal Length: 18mm	
Partial phase — TO SolarLite™ filter (ND 5.6)	Sensitivity (ISO): 100	Field of View: 90.0°x67.4° (100.5°)		
Partial phase — 1/10000 <sup>th</sup> filter (ND 5.0)		Exposure Limit (without tracking): 11 s		
Partial phase — 1/10000 <sup>th</sup> filter (ND 4.0)		Eclipse pictures courtesy of <a href="#">Joe Cali</a> and <a href="#">Miloslav Druckmüller</a>		
Baily's Beads (annular - with ND 5.6 filter)	Lens aperture (f/Number): 8	<b>Sampling</b>		
Baily's Beads (annular - with ND 5.0 filter)		Body: Nikon D850	Effective MPix: 45	
Baily's Beads (annular - with ND 4.0 filter)	<b>Suggested shutter speed:</b> <b>1/6400 s</b>	Pixel Size (in microns): 4.3µm x 4.4µm	Sampling: 4.43"/pixel	
Baily's Beads (total - without filter)		<b>Instructions</b>		
Chromosphere		With atmospheric extinction:	<ul style="list-style-type: none"><li>To display the suggested time exposure for one of the solar eclipse events, select the event, the sensitivity (ISO) and the lens aperture (f/number). The altitude of the Sun and elevation of the observer do have a measurable influence on the exposure time, just as the sky conditions. The time exposure will then be displayed and computed every time you modify one of those parameters.</li><li>The time exposures are only given as a guide. They will help you choosing a film matching your equipment and the event you are shooting. An automatic sequence can also be build accordingly. However, on the day of the eclipse, you should bracket your exposures one or more stops (+/-1EV or more) to take into account the actual sky conditions and the variable nature of these phenomena. If the sky is not clear or hazy, then lengthen the exposures.</li><li>The brightness (Q) and exposure value (EV) are computed after applying the atmospheric extinction.</li></ul>	
Prominences	<b>1/5000 s</b>			
Lower corona (<0.1 solar radius)	<b>Brightness (Q):</b> <b>11.6</b>			
Diamond Rings (±6s 2 <sup>nd</sup> & 3 <sup>rd</sup> contact)		<b>Exposure Value (EV):</b> <b>18.3</b>		
Inner corona (<0.2 solar radius)				
Inner corona (<1/2 solar radius)				
Middle corona (<1 solar radius)				
Upper corona (<2 solar radii)				
Outer corona (>3 solar radii)				
Outer corona (>4 solar radii)				
Outer corona (>8 solar radii)				
Earthshine				

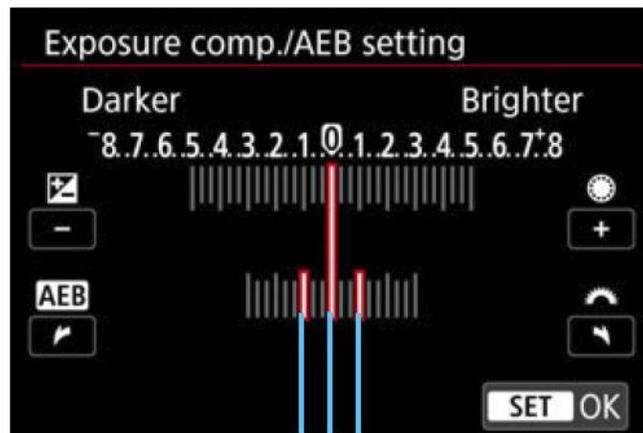
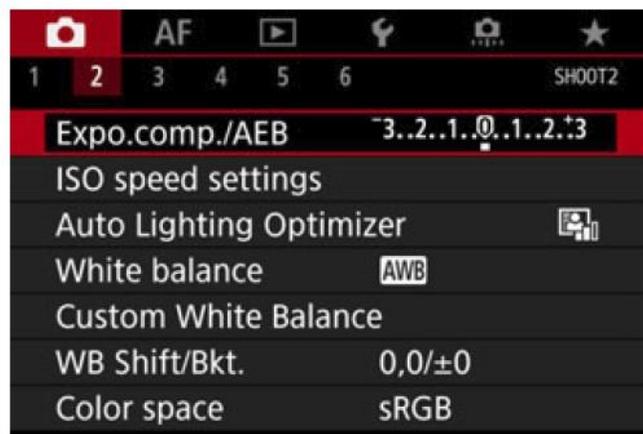
petite douche de pluie Humidité: 73% Vent: 22 km/h

© Xavier M. Jubier, 1991-2024. Last page update on July 3, 2017.

- NB: Shutter speeds suggested by the calculator are **estimates**.
- Once you select shutter speed setting for a particular feature, plan to bracket around that setting by several stops, e.g., +/- 1/3-stop; +/- 1/2-stop; +/- 2/3-stop; +/- 1-full stop. This will improve chances of success.



# Shutter Speed Calculator for Solar Eclipses by Xavier Jubier, [http://xjubier.free.fr/en/site\\_pages/SolarEclipseExposure.html](http://xjubier.free.fr/en/site_pages/SolarEclipseExposure.html)



AEB range



- If available on your camera, use Auto Exposure Bracketing, or AEB, to automatically change the shutter speed +/- several stops for 3 (or more) consecutive shots.
  - What is an “exposure stop”? See “Exposure Stops in Photography – A Beginners Guide”, by Romanas Naryškin (<https://photographylife.com/what-are-exposure-stops-in-photography>)
- Use of an intervalometer to automatically control how often the camera takes a shot and the number of shots taken.



# *Equipment Setup?*

- **Setup your equipment and practice imaging the sun Well BEFORE ECLIPSE DAY! Practice makes perfect!**
- **To Take Images:**
  - With DSLR, use “Live View” and Manual shooting mode:
    - **Using Live View, zoom in to focus precisely.**
    - **SHOOT IN RAW! Don’t bother with JPEG.**
    - **Use an intervalometer**
    - ISO: Your choice
    - Shutter Speed (Tv): Your choice
    - There is no set “best combination” of ISO & Shutter Speed settings; With digital imaging get instant results.
    - **BRACKET EXPOSURES as much as possible.**
    - Better to under expose your images than over expose to avoid losing detail by washing it out; can always lighten up an image, but can’t darken an over exposed image.





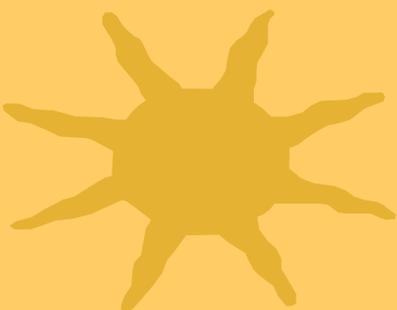
## *Setting Up a Tracking Mount?*

... If so, how can you polar align it, if you can't set-up and do it the night before?





# Easy Daytime Polar Alignment



- Use planetarium app on smart phone to do a rough polar alignment of your mount.
- App must be able to automatically align with the sky using the phone's internal compass and accelerometer. **NB: Enable GPS!**
- Mount smart phone on flat surface of lens cap or EQ wedge, using tape, elastic/bungy cord, etc.
- Phone will effectively be pointing downward, toward the South Celestial Pole.
- Adjust fine controls on EQ wedge/mount (i.e., azimuth & altitude), to center South Celestial Pole in Telrad circle or on crosshairs, and ...

Improved accuracy can be achieved if a third party compass app is used, e.g., GPS Status Pro, Digital Compass, etc.



... Voila!  
You're polar aligned!



Resource: Daylight Polar Alignment Made Easy, by Spencer R. Rackley IV, May 19, 2017 Sky & Telescope, <https://skyandtelescope.org/observing/daylight-polar-alignment/>



## *Resources*

1. “Solar Filters: Ready-made and Homemade”, by Susan Sawyer-Beaulieu, RASC Windsor Centre February 21, 2017  
(<https://www.rascwindsor.com/media/pdf/Solar%20Filters.pdf>)
2. “Getting Into Digital Solar Imaging”, by Susan Sawyer-Beaulieu, RASC Windsor Centre, April 18, 2017  
(<https://www.rascwindsor.com/media/pdf/Getting%20Into%20Solar%20Imaging.pdf>)
3. Interactive Google Map, by Xavier Jubier  
([http://xjubier.free.fr/en/site\\_pages/solar\\_eclipses/TSE\\_2024\\_GoogleMapFull.html](http://xjubier.free.fr/en/site_pages/solar_eclipses/TSE_2024_GoogleMapFull.html))
4. Shutter Speed Calculator for Solar Eclipses (v1.0.2), by Xavier Jubier  
([http://xjubier.free.fr/en/site\\_pages/SolarEclipseExposure.html](http://xjubier.free.fr/en/site_pages/SolarEclipseExposure.html))



## *Resources (cont.)*

5. Fred Espenak's website, MrEclipse.com  
(<https://www.mreclipse.com/MrEclipse.html>)
6. "Daylight Polar Alignment Made Easy", by Spencer R. Rackley IV, May 19, 2017 Sky & Telescope,  
(<https://skyandtelescope.org/observing/daylight-polar-alignment/>)
7. "Exposure Stops in Photography – A Beginner's Guide",  
Byromanas Naryškin, September 10, 2022,  
(<https://photographylife.com/what-are-exposure-stops-in-photography>)



